SPM®

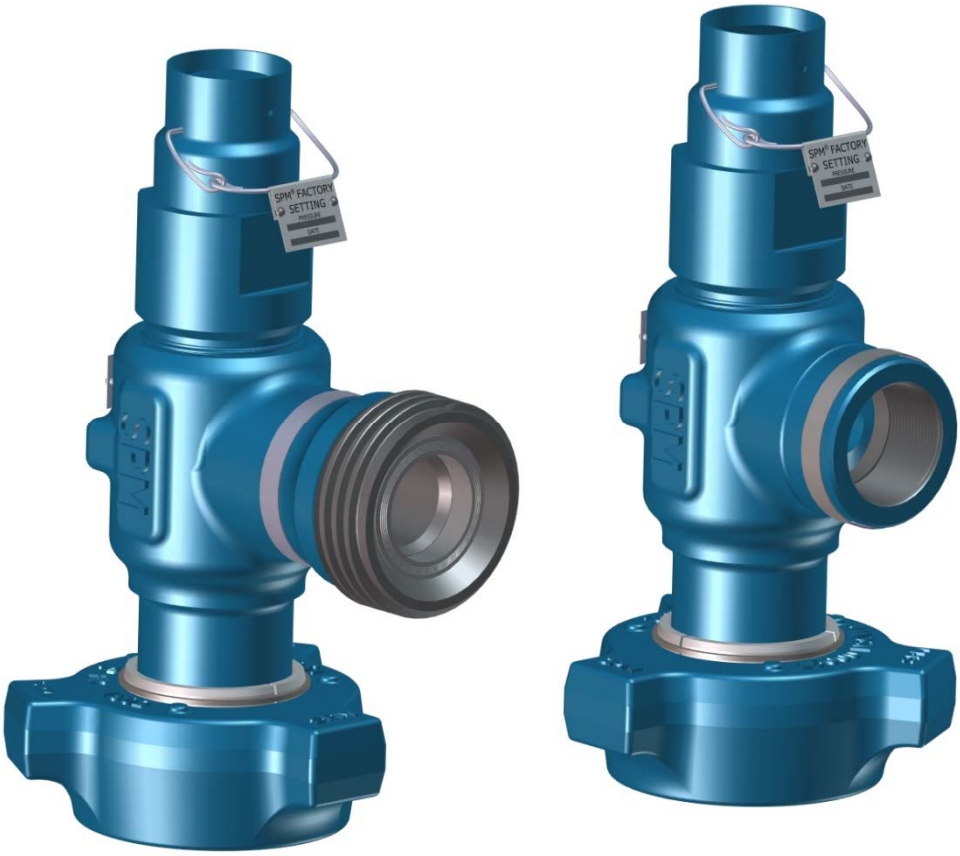
Well Service Pumps & Flow Control Products

Excellent
Oil & Gas
Solutions

WEIR OIL & GAS

Full Flow Emergency Relief Valves
Standard and H_2S Service Models: (Spring Design 2″ ERV's)

Operation Instruction and Service Manual



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THE FOLLOWING ICONS DENOTE IMPORTANT INFORMATION WITHIN THIS MANUAL.

GENERAL INFORMATION

INSTALLATION AND OPERATION

MAINTENANCE AND REPAIR

SALES AND SUPPORT

NOTE

CAUTION

WARNING/ DANGER

SPM® PRODUCT SAFETY GUIDE

IMPORTANT SAFETY INFORMATION ENCLOSED. READ THIS OPERATING AND MAINTENANCE INSTRUCTIONS MANUAL BEFORE OPERATING PRODUCT.

THIS INFORMATION MUST BE AVAILABLE TO ALL PERSONNEL THAT WILL OPERATE AND MAINTAIN EQUIPMENT. FAILURE TO READ, UNDERSTAND AND FOLLOW THE OPERATING AND MAINTENANCE INSTRUCTIONS MANUAL COULD RESULT IN **SEVERE PERSONAL INJURY OR DEATH!**

Most SPM® products generate, control or direct pressurized fluids; therefore, it is critical that those who work with these products be thoroughly trained in their proper application and safe handling. It is also critical that these products be used and maintained properly!!

SPM® flow products contain elastomeric seals and are not intended to provide proper functionality when exposed to fire.

MISUSE, SIDE LOADING, IMPROPER MAINTENANCE, OR DISASSEMBLY UNDER PRESSURE CAN CAUSE SERIOUS INJURY OR DEATH!

The following information is given in good faith and should aid in the safe use of your SPM® products. This information is not meant to replace existing Company's safety policies or practices.

Personal Responsibilities:

1. When working on SPM® flow control products, safety glasses, approved safety shoes and hard hat must be worn.

2. Personnel should never hammer on any component when pressure is present. Hammering on any part or component may also cause foreign material or steel slags to become airborne.

3. It is a personal responsibility to use the proper tools when servicing the valve. It is a personal responsibility to be knowledgeable and trained in the use and handling of tools for all maintenance of the valve.

4. Hot surface may be present; it is a person's own responsibility to protect against burn injury.

On Location:

1. Each valve is clearly marked with a maximum pressure rating. This pressure must not be exceeded or **SERIOUS INJURY OR DEATH CAN OCCUR!**

2. The valve discharge connections should be properly cleaned and lightly oiled before the downstream piping is attached. Any worn, damaged or missing seals should be replaced.

3. Welding, brazing or heating any part of the valve is prohibited. If accessories must be attached, consult Weir Oil & Gas factory prior to installation.

4. A complete visual inspection of the valve must be made prior to each use. Any leaking seals, broken bolts, leaking hoses or improperly tightened parts must be remedied prior to using.

5. Any repairs or service (even routine maintenance) performed on the valve must be performed by a trained service technician who is qualified to work on high pressure flow control valves. All such service and repairs must be supervised by qualified management personnel or returned to Weir Oil & Gas for service. Only SPM® replacement parts should be utilized. Failure to do so may result in loss of warranty as well as **SERIOUS INJURY OR DEATH!**

Special Precautions:

1. The modifications to or unauthorized repair of any part of a SPM® valve, or use of components not qualified by SPM® , can lead to valve damage or failure and **SERIOUS INJURY OR DEATH!**

2. All SPM® threaded components are right hand threaded unless specifically designated otherwise. Any turning counterclockwise will unscrew the assembly. Make sure all threaded components are assembled to the correct torque value.

3. All products should be properly cleaned, greased or oiled after each use and inspected prior to each use.

4. Each integral union connection is clearly marked with a pressure code (i.e. “1502”, 15,000 psi). This pressure must not be exceeded. This code should also be used with mating unions. Improper mating can result in failures. All integral union connections used must match (according to size, pressure rating, etc.). These connections must also match the service of the designated string they are installed in.

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SECTION I: General Information

This service manual covers:

Part Number	Size	Connection Type	Outlet/Branch Configuration	Temperature	Service Type
2A18138	2"	Hammer Union	2" LPTL F Outlet	Low Temp	Standard
2A18192	2"	Hammer Union	2" 1502F Outlet	Low Temp	Standard
2A18796	2"	Hammer Union	2" 2002F Outlet	Low Temp	Standard
2A18544	2"	Hammer Union	2" 1502F Outlet	Low Temp	H2S

Rebuild Kits:

Relief Valve Part Number	Full Parts Kit Number	Ball, Seat & Seal Kit	Seal Kit
2A18138	4L20418	4L18755	4L20423
2A18192	4L20418	4L18755	4L20423
2A18796	4L20422	4L19186	4L20426
2A18544	4L18755	4L20417	4L20424

Product Description:

SPM® Emergency Relief Valve provides overpressure protection for reciprocating pumps, treating lines, pressure vessels, and other equipment operating under high pressure, high flow conditions. Compact and simple to operate, the valves are direct acting, relying on the system's hydraulic pressure to overcome a preset spring force to relieve. They are externally adjustable from zero pressure to maximum setting.

Unlike shear relief valves, which use common nails to trigger the release, the SPM® valves will reseat once the system pressure reduces. And unlike many "High-Lift" Valves, which require a substantial drop in pressure before they will reseat, the SPM® relief valve exhibits little blow down and will reseat at or near the "cracking pressure."

Manufactured to Weir Oil & Gas stringent Quality Assurance System, all pressure bearing components are made from high quality material. The forged body features an integral wing union male inlet, suitable for the pressure rating of the component.

The low pressure outlet is available with an integral wing union female connection. Conforming to conditions of design and performance in API RP520, the SPM® Emergency Relief Valves are intended for liquid service. They are not intended for elevated temperatures or as a safety device in case of fire.

Available in 2", 3" and 4" sizes, these valves offer pressure ranges from 0 PSI to 20,000 PSI. The valves are best suited for over pressure protection in a "slick water" medium. (See 3"-4" Emergency Relief Valve Service Literature for information regarding the 3"-4" E.R.V)

WARNING: STANDARD 2" RELIEF VALVES SHALL NOT BE USED FOR H2S SERVICE!

WARNING: DO NOT BLOCK RELIEF VALVE DISCHARGE!!

General Description of Relief Valve Operation:

The SPM® Back Pressure Relief Valve's operation is a simple balance between the spring loaded keeper which holds the ball in the seat and the inlet liquid pressure acting on the ball.

The spring pressure is set by tightening the Hex Bolt on top which pushes on the keeper which in turn compresses the Belleville springs that forces the keeper on the Ball. When the inlet fluid pressure rises and overcomes the set spring pressure, the ball is lifted off its seat thereby discharging fluid to the outlet end. Once the pressure of the inlet fluid falls below the set spring pressure, the ball will be pushed back on to its seat and the fluid can pass downstream.

End Connection Options:

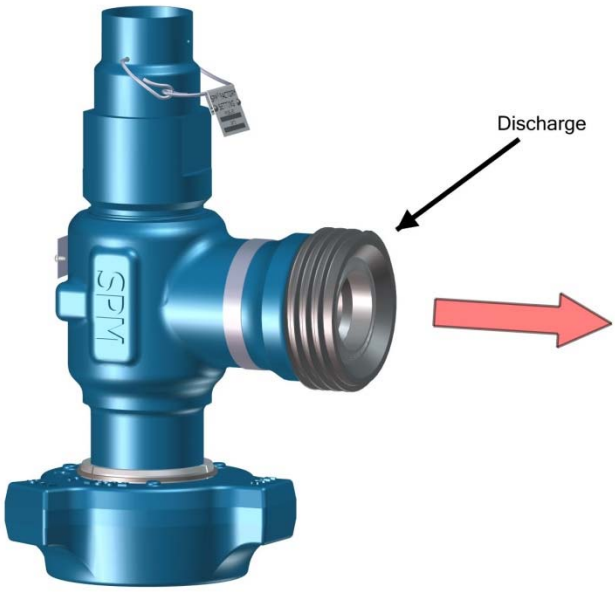
The SPM®'s 2" Emergency Relief Valves are available with SPM® wing union and Safety Iron end connections. The nameplate will indicate the cold working pressure allowable for each assembly.

SPM® wing union connections on the relief valves are interchangeable with other union connections of the same size and figure (pressure rating). Caution must be taken to avoid mixing different ratings of wing connections. There are various sizes and figures that are capable of making marginal connections. Failure to observe good judgment may lead to failure of components and danger to life and limb. Always verify working pressure ratings of each connection before use.

This device is intended to discharge to atmospheric pressure when it relieves. It should not be subjected to any significant back pressure. The choice of discharge connections is offered as a convenience for the user and does not imply high pressure capability.

WARNING: OBSERVE ALL INSTRUCTIONS, CAUTIONS AND WARNINGS AS NOTED IN THIS MANUAL. FAILURE TO DO SO CAN LEAD TO EQUIPMENT DAMAGE AND **PERSONAL INJURY OR DEATH!**

Figure 0



SECTION II: Installation and Operation

Installation:

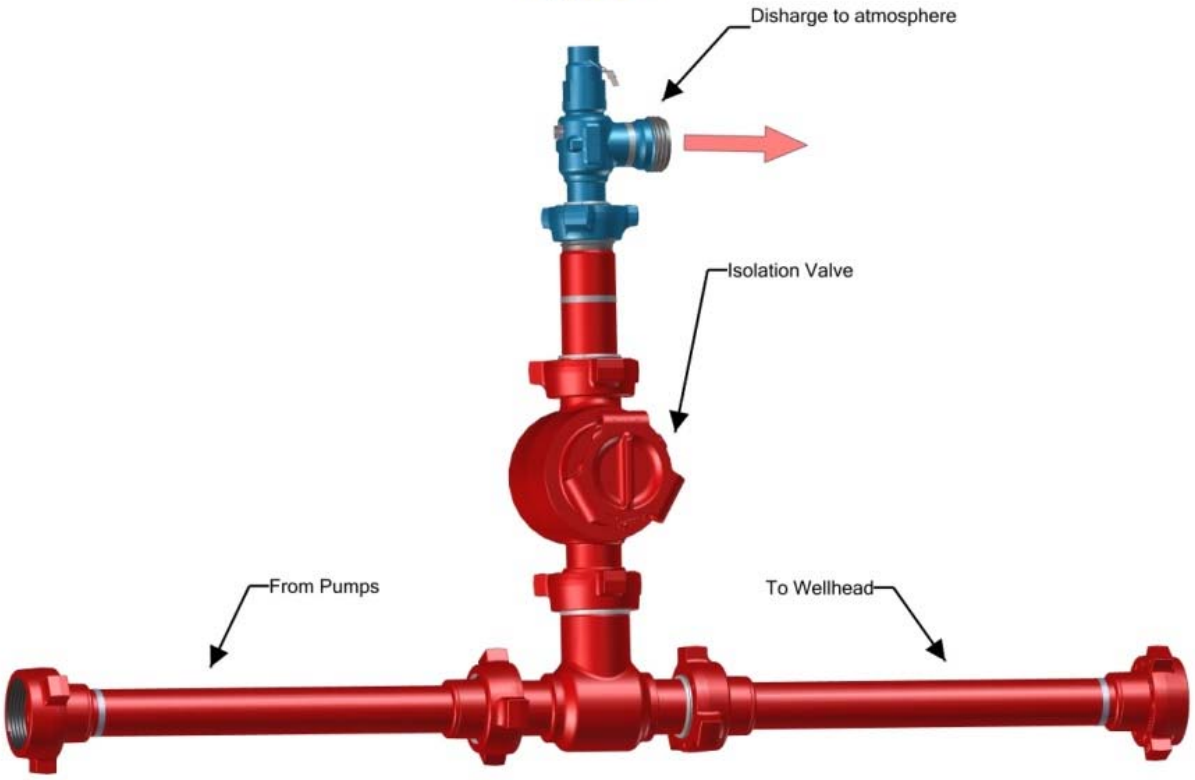
SPM®'s 2" Relief Valve should be installed in a branch on the high-pressure pump line (Figure 1). It is recommended that the valve be placed downstream away from the high pressure pumps. This increased distance will reduce the likelihood of the valve seat's experiencing "chatter". However, any application requiring localization protection of the high pressure pump is acceptable. This will require additional differential between the fluid pressure and set pressure of the valve to prevent "valve chatter". Contact Engineering for additional recommendations.

The valve should be mounted in the vertical position, as shown, to reduce the tendency of contaminants and particles in the fluid from collecting at the throat of the ball seat. Although any type of fluid may be relieved through the valve, the slick water media will allow for reseating (and therefore resealing); whereas proppants may become trapped in the ball and seat sealing area and inhibit resealing. This is also true of contaminants.

IT IS IMPORTANT FOR THE USER TO CONSIDER THE CONSEQUENCES OF A VALVE THAT DOES NOT FULLY RESEAT AFTER IT HAS RELIEVED. IN THE EVENT THAT THIS MIGHT PRESENT A DANGER TO PERSONNEL OR EQUIPMENT, WEIR OIL & GAS HIGHLY RECOMMENDS THAT AN ISOLATER VALVE BE PLACED BETWEEN THE PRESSURE LINE AND THE RELIEF VALVE.

With the valve installed, as shown in Figure 1, any time the pressure exceeds the pop off pressure of the Relief Valve, the fluid will pass through the valve and out the discharge.

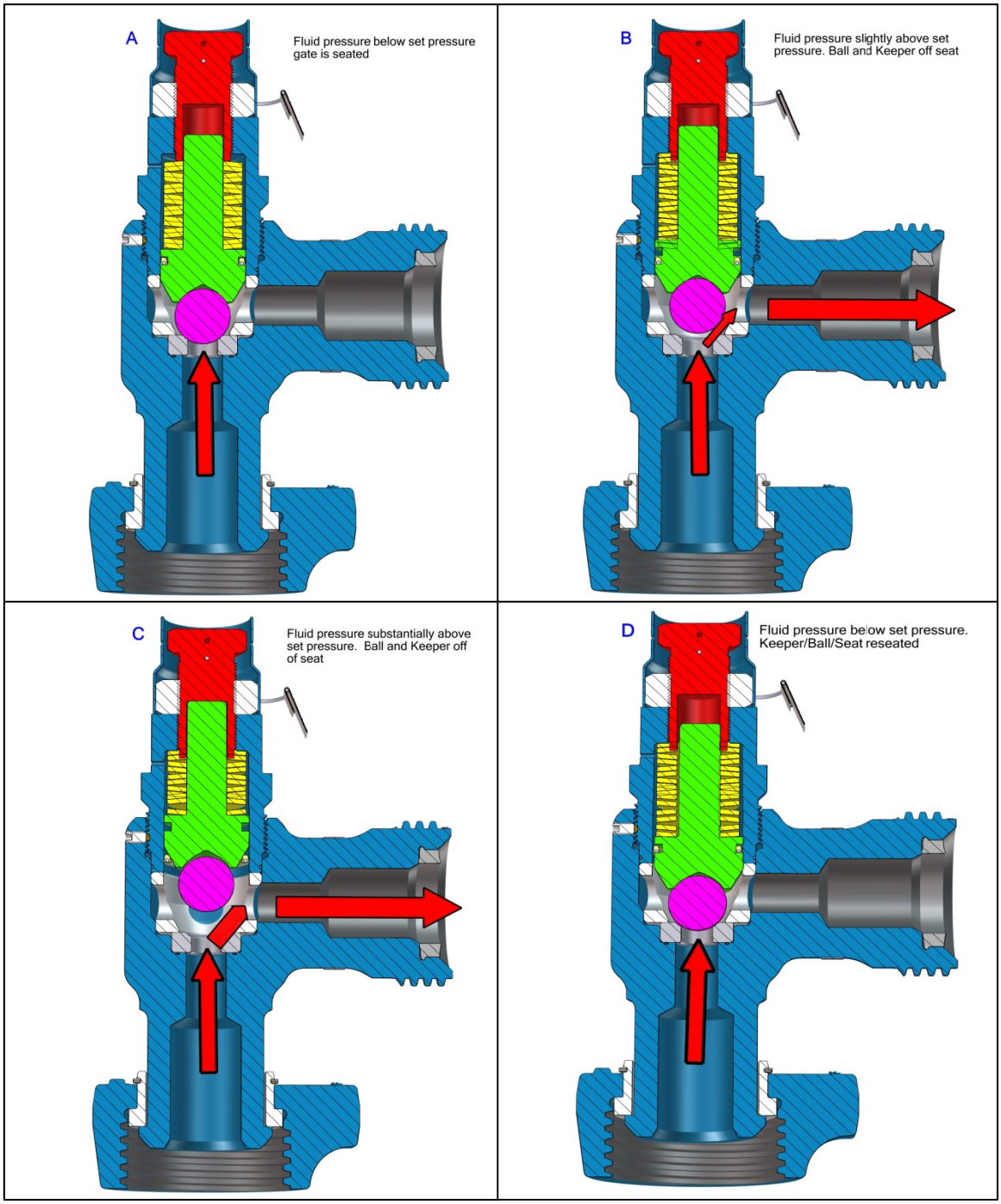
Figure 1



Installation Cont:

At low flow rates, the valve will discharge fluid at approximately the set pressure Figure 2 (A through D). At higher flow rates, the valve will discharge fluid at levels above the set pressure. API 520 defines the valve flow capacity as the rate that can be relieved at an over pressure of 25%. When the fluid pressure falls to the set pressure level or below, the valve will reseat and reseal.

Figure 2


A
Fluid pressure below set pressure gate is seated
B
Fluid pressure slightly above set pressure. Ball and Keeper off seat
C
Fluid pressure substantially above set pressure. Ball and Keeper off of seat
D
Fluid pressure below set pressure. Keeper/Ball/Seat reseated

Calibration Guide:

Pressure/ Temperature Ratings:

Inlet	Low Pressure Discharge	Pressure Range	Int. End NSCWP	Service	Temp. Range
2" - 1502M	2" LPTL	0 - 15000	15000	Standard	-30°C - 110°C
2" - 1502M	2" - 1502F	0 - 15000	15000	Standard	-30°C - 110°C
2" - 2002M	2" - 2002F	0 - 20000	20000	Standard	-30°C - 110°C
2" - 1502M	2" - 1502F	0 - 10000	15000	H2S (Sour)	-30°C - 176°C
2" - 2202M	2" - 2202F	0 - 15000	10000	H2S (Sour)	-30°C - 176°C

SECTION III: Maintenance and Repair

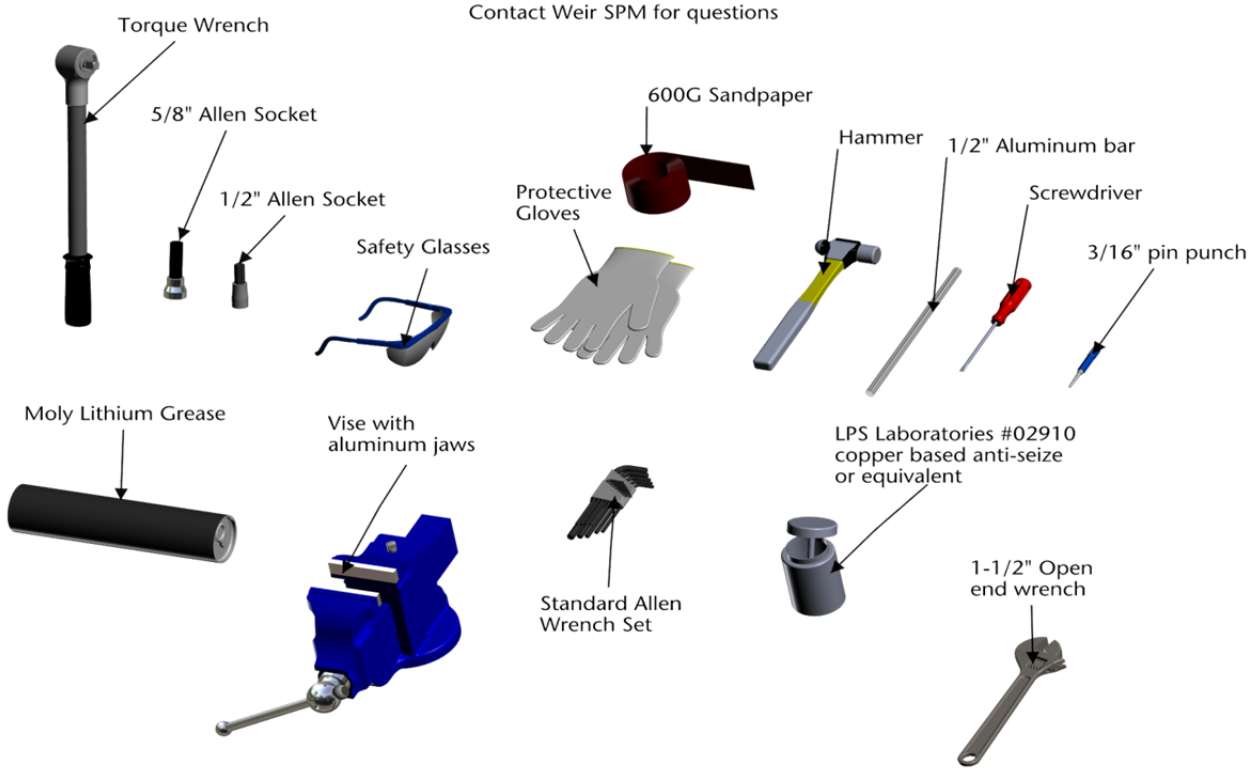
WARNING: DISASSEMBLY UNDER PRESSURE CAN CAUSE **SERIOUS INJURY OR DEATH!**

Always Remember:

1. Always wear PPE (personal protective equipment).
2. Only qualified technicians should perform maintenance on SPM® products.
3. Always use SPM® supplied new parts kit for reassembly.
4. Clean all components thoroughly prior to reassembly.
5. Check sealing surface area of valve gate and nozzle for pitting, erosion or other flaws. Failure in sealing can result if these areas are not smooth.
6. Use only SPM® parts on SPM® valves.
7. This device is intended to discharge atmospherically when it relieves.

Required Tools:

Contact Weir SPM for questions



Maintenance Requirements:

The SPM® 2" Emergency Relief Valve is a well-designed, dependable valve that provides long term reliable performance. Like any device, however, it requires routine inspection and servicing to guarantee that it is fully functional. Due to the harsh field environment where this relief valve will be used, it is imperative that maintenance of this valve be HIGH Priority to ensure repeatability.

Weir Oil & Gas recommends that the valve be serviced during the following:

1. ***Preventative Maintenance (After 20 Fracturing Stages, or 1 Complete Frac Job)***

The life of replacement kits may vary considerably, based on the application and operating conditions. However, Weir Oil & Gas provides the following recommendations:

Any time the valve is sequenced in operation as a result of overpressure (other than routine calibration with clean water prior to pumping operations), it must undergo a teardown and the primary seal surfaces be inspected. If no over-pressure event occurs, the valve shall be serviced after every 20 stages or 1 frac job, whichever comes first. This should be done immediately following the completion of the current job.

Specific applications combined with implementation of "best practice" procedures may result in longer kit life and reduced service interval. Contact Engineering for more details.

Not properly servicing the valve once it has discharged frac media (including frac sand) is a dangerous practice and increases the risk of leakage during the next operation. Disassembly, repairs, and reassembly should be done in accordance with service manual instructions.

The valve's design allows for a quick and easy inspection of its internal components. The components that require inspecting are listed below and are referenced on the bill of materials on page 15. (Illustrated on pages 16-18):
(The components that must be replaced during a re-kitting are highlighted in yellow and shown on Page 14)

- Ball
- Ball Seat
- Seat Seal
- Disk Spring
- Keeper
- Bushing
- Spider
- Other Applicable Seals

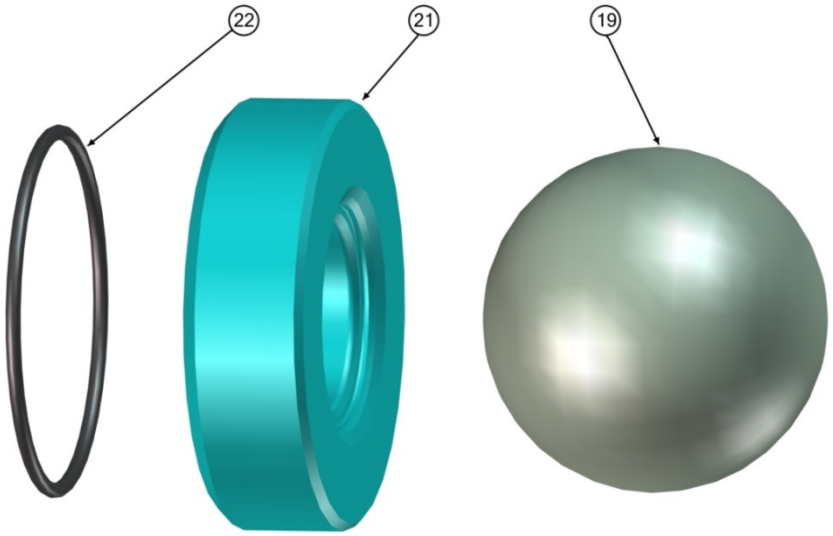
Disassembly/Inspection guidelines are on pages 19 through 28.

2. ***Annually Inspection***

An annual inspection is required to ensure that all internal components of the valve are working properly and are to Weir Oil & Gas Engineering's specifications. It is imperative that a qualified Weir Oil & Gas Technician follow the assembly/disassembly/inspection instructions illustrated on pages 19 through 35.

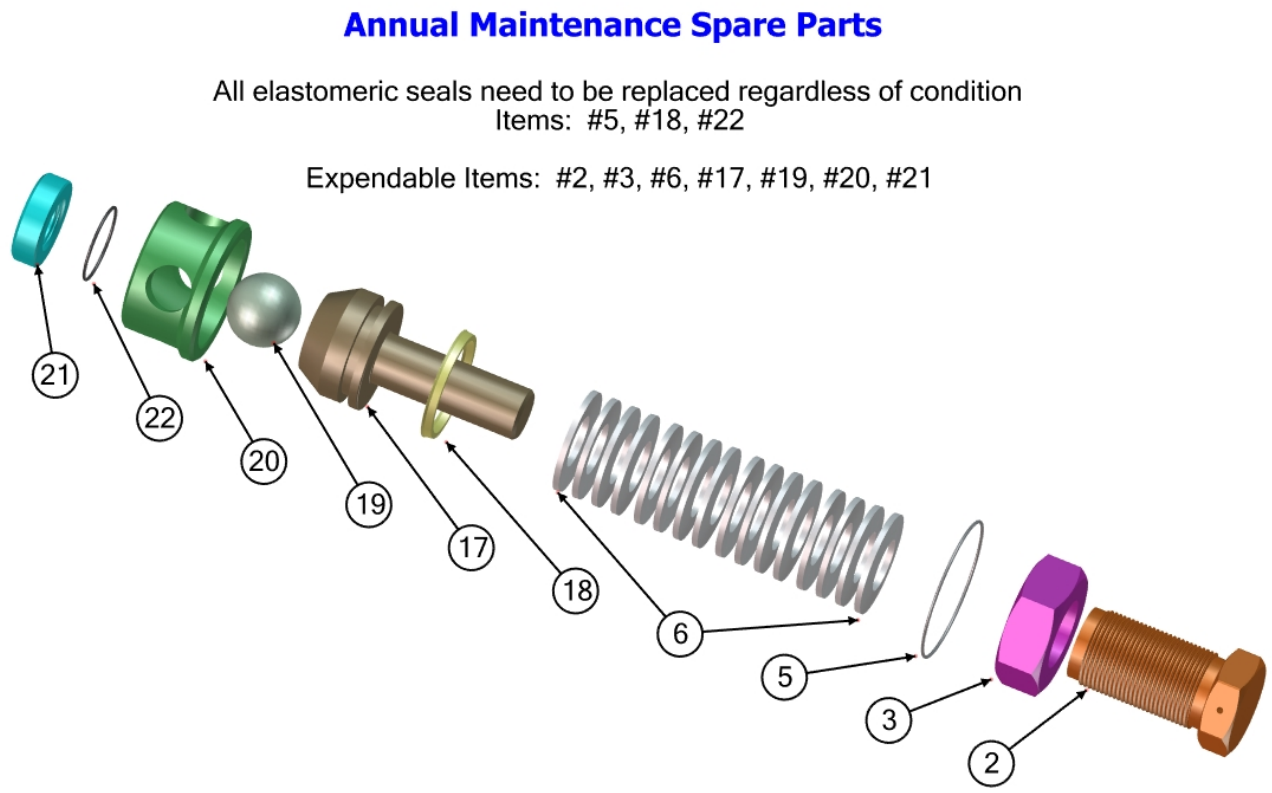
Preventative Requirements:

Regular maintenance spare parts. Item # 19, 21, 22



BALL & SEAT & SEAT SEAL KIT						
Relief Valve PN - Service type	Part No.	Seal Type	Description	#19, Ball	#21, Seat	#22 Seat Seal
2A18138 - STD SERVICE 2A18192 - STD SERVICE 2A18796 - STD SERVICE	4L18755	BUNA	1.5K/3.0K/7.5K/15K Std Service	P18919	2P19460	P28332
2A18138 - STD SERVICE 2A18192 - STD SERVICE 2A18796 - STD SERVICE	4L18756	VITON	1.5K/3.0K/7.5K/15K Std Service, 10K H2S Service	P18919	2P19460	P28332
2A18544 - H2S SERVICE						
2A18797 - H2S SERVICE	4L20417	VITON	15K H2S Service	P18919	2P19646	P18883
2A18796 - STD SERVICE	4L19186	BUNA	20K Std Service	P18919	2P19646	P18882

Annual Requirements:



Elastomer Seals:

Relief Valve PN - Service type	Pressure (PSI)	Part Number	Description	#5, Cap Seal	#18, Keeper Seal	#22, Seat Seal
2A22465 - STD	1500	4L22456	Buna - Std Service	P18152	P18153	P28332
		4L22457	Viton - Std Service	P18131	P24147	P28332
2A23783 - STD	3000	4L24007	Buna - Std Service	P18152	P18153	P28332
		4L24008	Viton - Std Service	P18131	P24147	P28332
2A23782 - STD	7500	4L24009	Buna - Std Service	P18152	P18153	P28332
		4L24010	Viton - Std Service	P18131	P24147	P28332
2A18192 - STD 2A18138 - STD	15000	4L20418	Buna - Std Service	P18152	P18153	P28332
		4L20419	Viton - Std Service	P18131	P24147	P28332
2A18544 - H2S	10000	4L20420	Viton - H2S Service	P18131	P24147	P28332
2A18797 - H2S	15000	4L20421	Viton - H2S Service	P18131	P24147	P18883
2A18796 - STD	20000	4L20422	Buna - Std Service	P18152	P18153	P18882

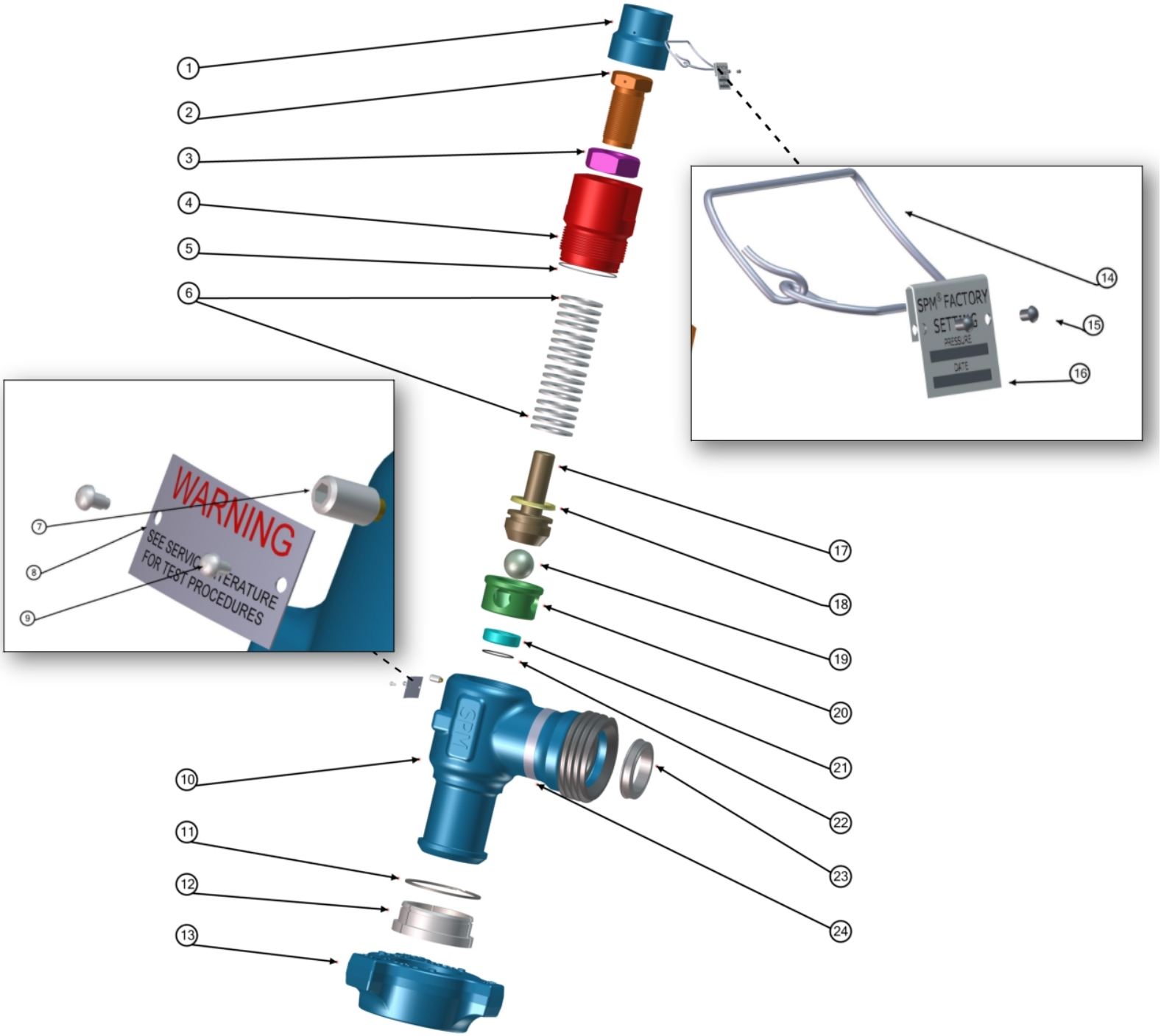
Expendable Items:

Relief Valve PN - Service type	Pressure (PSI)	Part Number	Description	#2, Adjusting Screw	#3, Lock Nut	#6, Disk Springs	No of Disk Springs	#17, Keeper	#19, Ball
2A22465 - STD	1500	4L22456	Buna - Std Service	3P18148	P18151	3P22455	16	3P18139	P18919
		4L22457	Viton - Std Service	3P18148	P18151	3P22455	16	3P18139	P18919
2A23783 - STD	3000	4L24007	Buna - Std Service	3P18148	P18151	3P22455	20	3P18139	P18919
		4L24008	Viton - Std Service	3P18148	P18151	3P22455	20	3P18139	P18919
2A23782 - STD	7500	4L24009	Buna - Std Service	3P18148	P18151	3P18149	14	3P18139	P18919
		4L24010	Viton - Std Service	3P18148	P18151	3P18149	14	3P18139	P18919
2A18192 - STD 2A18138 - STD	15000	4L20418	Buna - Std Service	3P18148	P18151	3P18149	16	3P18139	P18919
		4L20419	Viton - Std Service	3P18148	P18151	3P18149	16	3P18139	P18919
2A18544 - H2S	10000	4L20420	Viton - H2S Service	3P18148	P18151	3P18149	16	3P18139	P18919
2A18797 - H2S	15000	4L20421	Viton - H2S Service	3P18148	P18151	3P18149	16	3P18139	P18919
2A18796 - STD	20000	4L20422	Buna - Std Service	3P18148	P18151	3P18149	16	3P18139	P18919

BOM:

2A18192 BOM TABLE			
BOM ID	QTY	PART NUM	DESCRIPTION
1	1	2A18303	FACT SEAL INST/RELIEF VA/2-3FF OPTION #1
2	1	3P18148	SCRW/ADJ/2 RLF VA/LO-TMP
3	1	P18151	1 1/2-12UNF HEX NUT, JAM
4	1	2P18141	CAP/2 RELIEF VA
5	1	P18152	SEAL/OR26327506
6	16	3P18149	SPRNG/DISK/RLF VA/STL
7	1	P18294	SCRW/SHSS/ .31-18NC X .50/BRASS TIP
8	1	2P27625	ERV/WARNING LABEL
9	2	P18055	SCRW/DRV/4 X 3/16/TYPE U
10	1	2P18191	BDY/RELIEF VA/2-1502MXF
11	1	P10232	RET RNG/2-1502
12	3	3P10231	RET SEG/2-1502
13	1	3P10228	WING NUT/2-1502
14	1	3P18293	CAP/FACT SEAL/RELIEF VA/2
15	2	P18386	RIVET/POP/.13 DIA X .13 LG ALUMINUM
16	1	4P18296	NAMEPLT/FACT SEAL
17	1	3P18139	RELIEF/EMERG/KEEPER/2
18	1	P18153	1-3/4 x 2-1/8 x .187 SEAL
19	1	P18919	BALL/1.38/COBOLT
20	1	3P18140	SPDR/2 RLF VA/LO-TMP
21	1	2P19460	SEAT/2 RLF VA/.750 BORE/COBOLT
22	1	P28332	SEAL/OR2-028/ANTI-EXT
23	1	4P10229	SEAL RNG/UNION/2
24	1	3P17138	DATA BAND

Exploded View

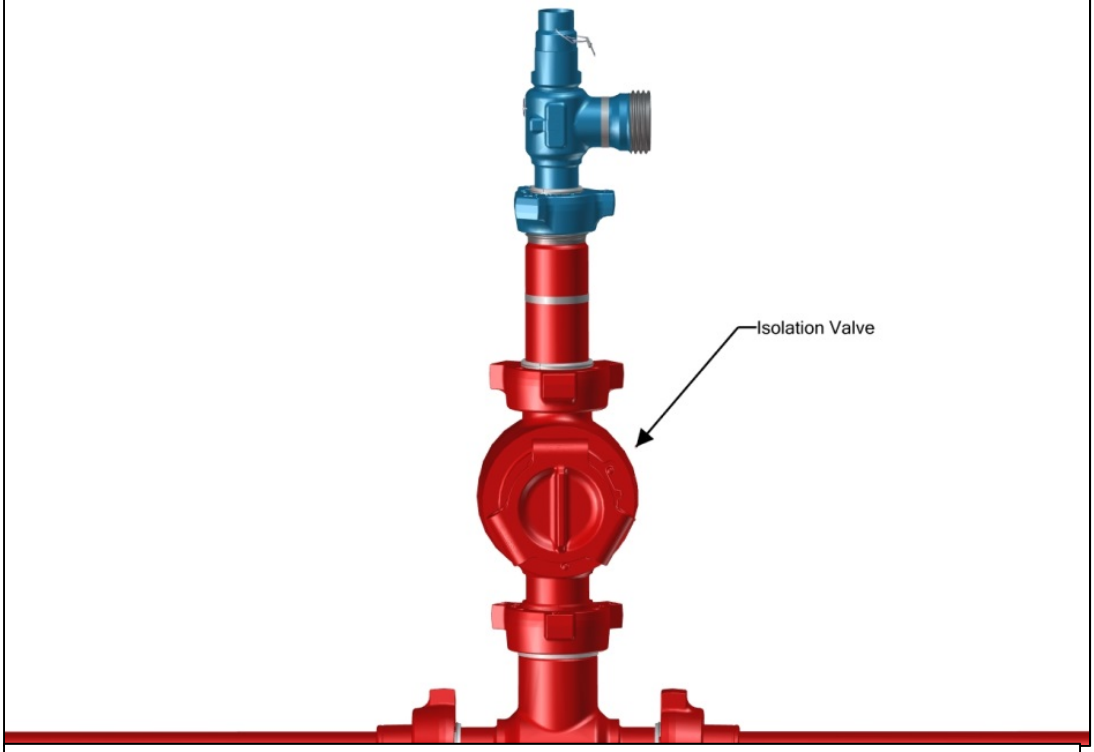


Preventative Maintenance and Disassembly:

ENSURE ALL PRESSURE IS RELIEVED PRIOR TO PERFORMING ANY MAINTENANCE OR DISSASEMBLY!

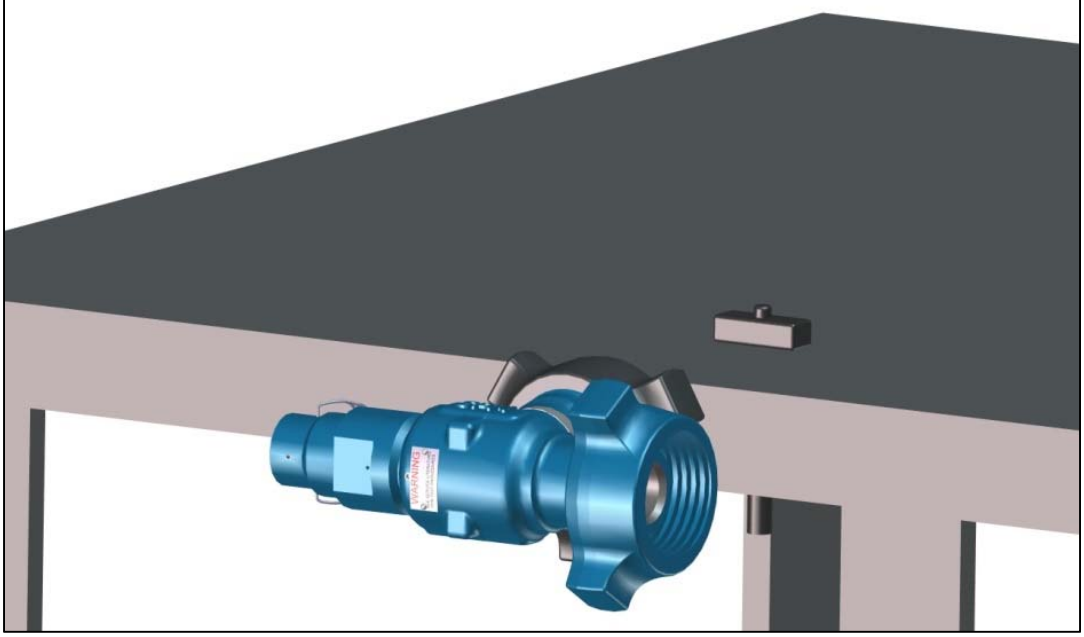
STEP 1

- Close Isolation Valve to shut off fluid pressure.
- Detach and remove Spring Loaded ERV from System.



STEP 2

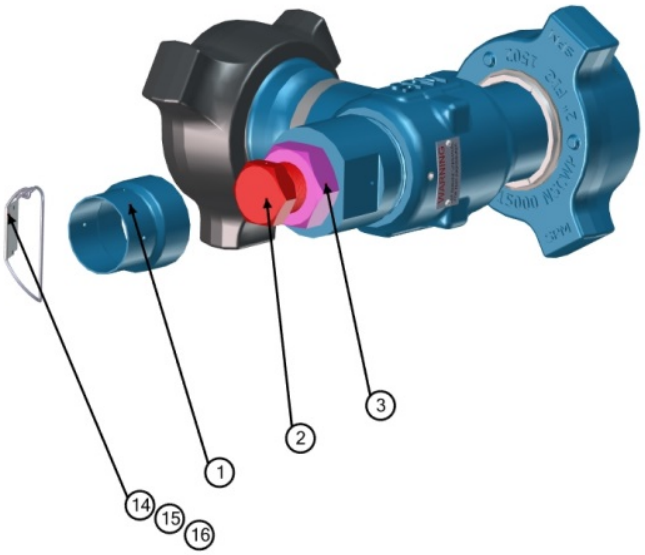
- Secure the Relief Valve in a horizontal position on an appropriate workstation as shown.



Preventative Maintenance and Disassembly (Cont.):

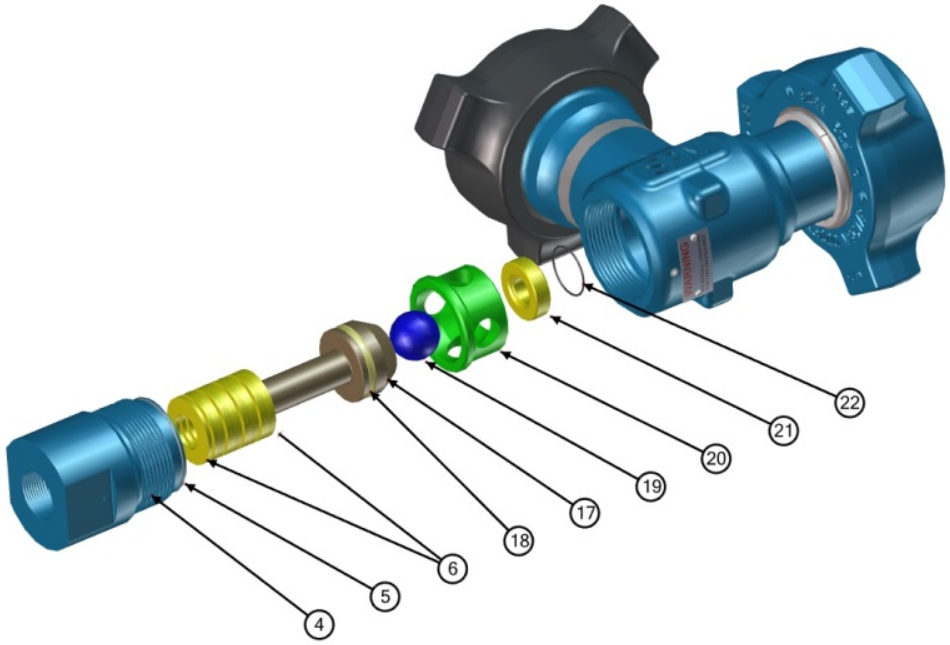
STEP 3

- Remove the Factory Pressure Assembly (14,15,16) and Fact Seal Assembly (1)
- Loosen the Hex Lock nut (3)
- Remove the adjusting screw (2) with the Lock Nut (3)



STEP 4

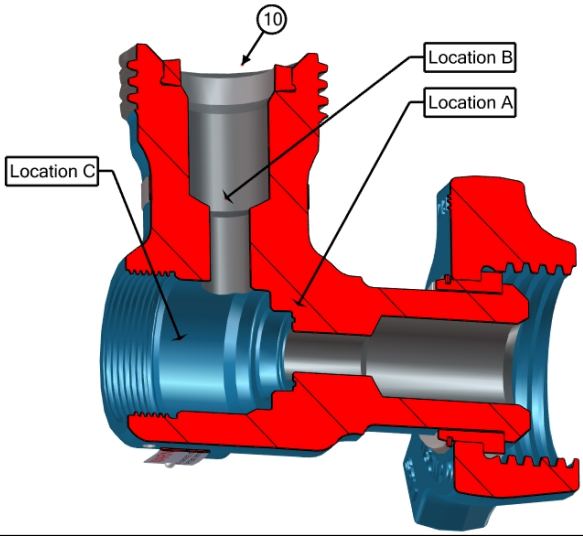
- Remove Cap (4), Cap Seal (5), Springs (6), Keeper (17), Keeper Seal (18), Ball (19), Spider (20), Seat (21), Seat Seal (22)



Preventative Maintenance – Inspecting Internal Components

Body (10)

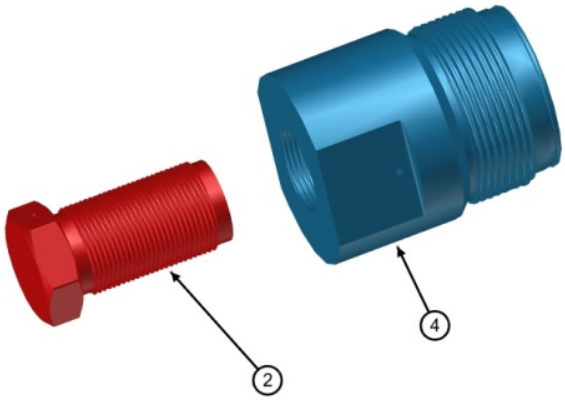
- Visually inspect the o-ring groove area beneath the ball seat(Location A). This is a critical area. If the groove shows indications of damage from either erosion or corrosion, the body should be replaced. It is not repairable.
- Visually inspect the fluid discharge surface for erosion or corrosion (Location B). Some wear in this area is expected. Any damage to this surface that extends deeper than .10" renders the part unusable and it should be replaced.
- Visually inspect the valve cap seal surface for erosion or corrosion (Location C). Damage to this area will allow fluid to leak past the cap during the relieving function. If this surface shows signs of damage, the body should be replaced.



Adjusting Screw (2) & Valve Cap (4)

- Visually inspect the cap/body and cap/spider seal areas for indications of damage or wear. These seals keep valve fluid from leaking out of the valve past the body to cap threads, and from leaking into the spring cavity. If these areas show signs of damage, replace the cap.

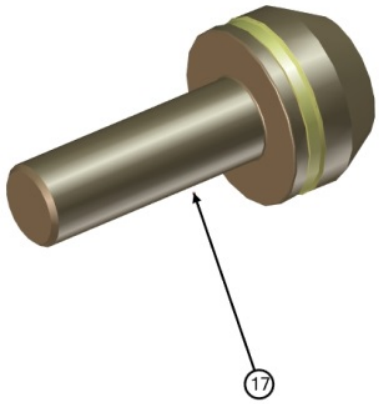
- Visually inspect the adjusting screw threads and mating threads in the cap for indications of damage or wear. Lubricate the adjusting screw and engage it into the cap by hand. The action should be free and easy. Damage to the cap threads or adjusting screw render these components unusable and they should be replaced.



Preventative Maintenance – Inspecting Internal Components (Cont.):

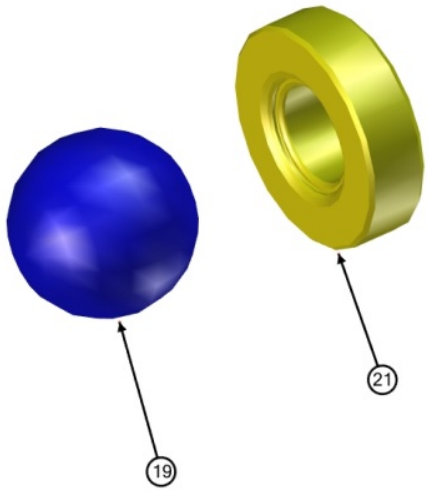
Keeper (17)

- Visually inspect the keeper, keeper stop, and piston seal surfaces for wear. Inspect the lock nut thread area for wear or galling.
- Visually inspect the disk spring support area for damage due to the disk springs. Inspect the ball mating area for unusual dents or damage from the ball or fluid. If damage or wear is evident, the keeper should be replaced.



Ball (19) & Seat (21)

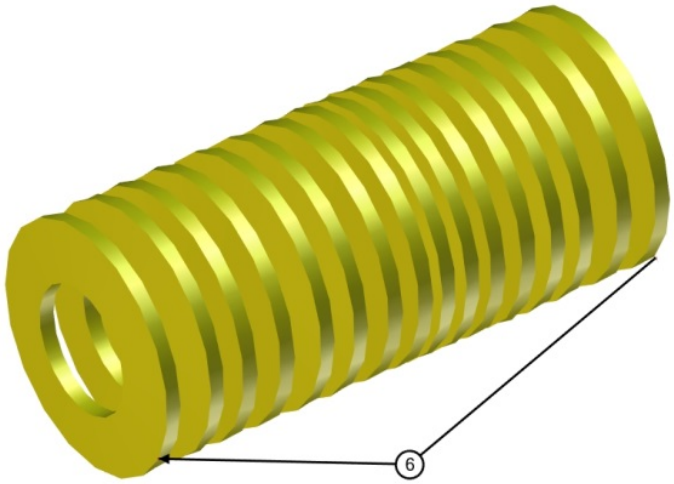
- The ball and seat are considered expendable items and spares should be kept on hand at all times. The life of these parts is dependent on the type and length of service to which they are exposed.
- Visually inspect the ball and seat for indications of pitting, erosion or corrosion damage. These are critical components in the function of the valve. Any indications of deterioration should be cause to replace these items. Look for contaminants that, while not damaging to the ball and seat, will keep the parts from sealing. Remove any foreign material found.



Preventative Maintenance – Inspecting Internal Components (Cont.):

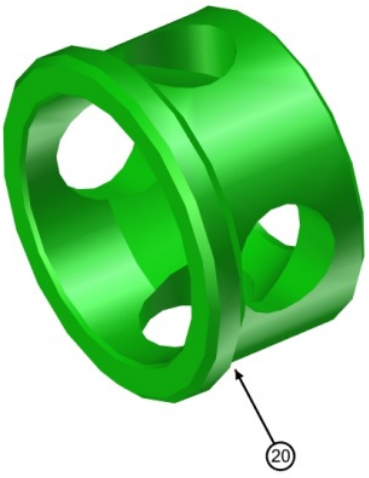
Disk Springs (6)

- Visually inspect the surface of the springs for damage due to corrosion or mechanical failure. This is a critical component in the function of the valve. Any indication of deterioration should be cause for replacing these items.



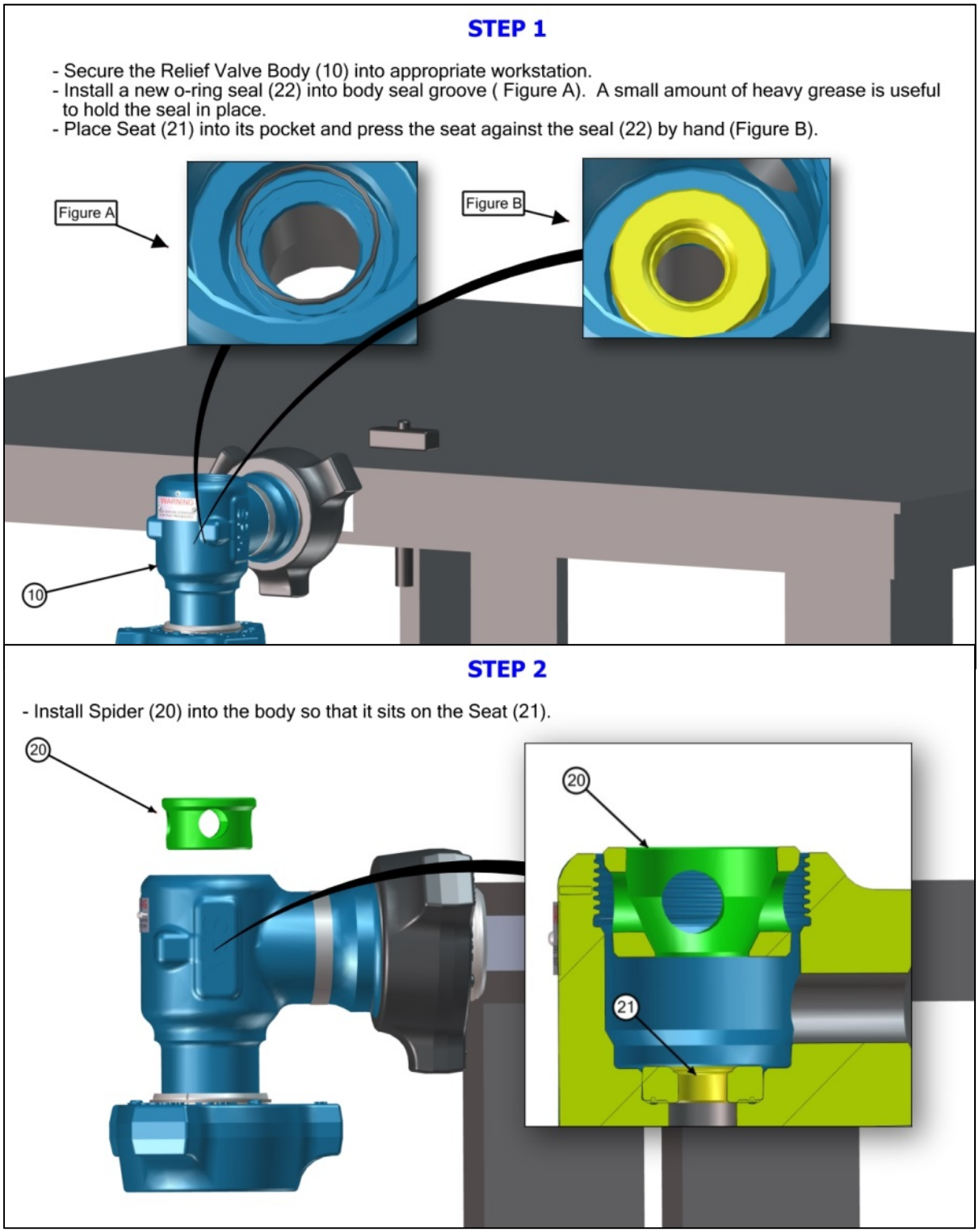
Spider (20)

- Visually inspect the fluid discharge area for erosion or corrosion. Some wear in these areas are expected. Any damage in this area that extends deeper than 0.06" renders the part unusable and it should be replaced.
- Visually inspect the keeper seal area and spider seal surface for signs of wear or damage. Replace the spider if damage exists.



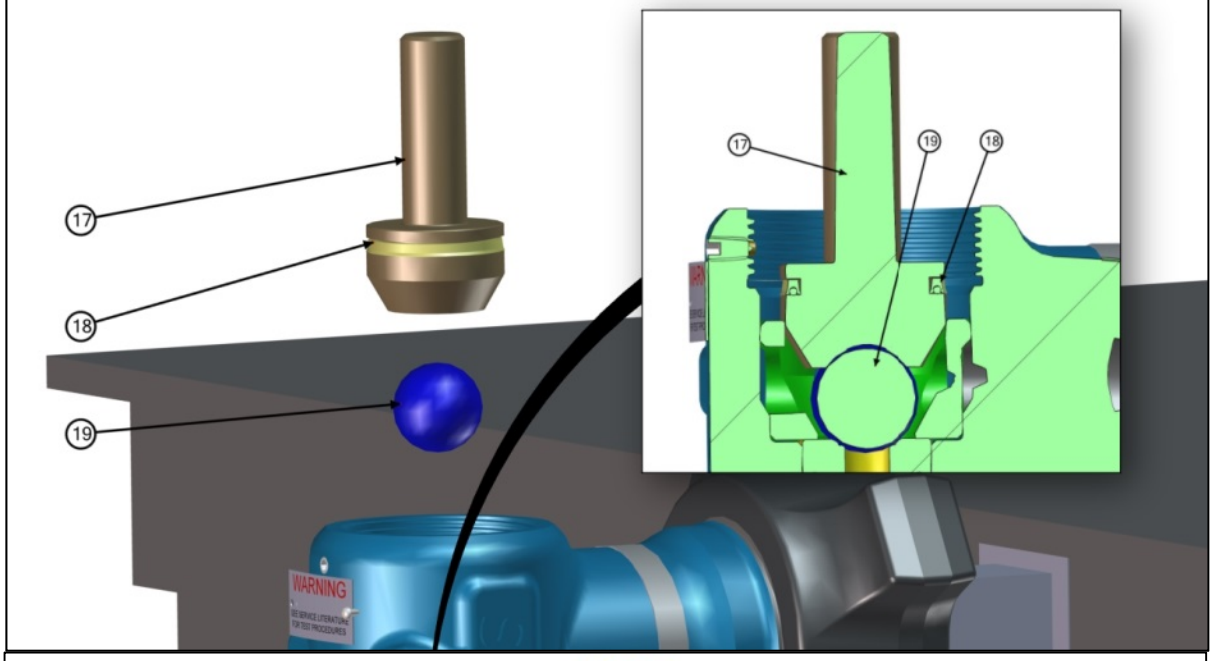
Preventative Maintenance – Inspecting Internal Components (Cont.):

Replacement and Assembly


STEP 1
- Secure the Relief Valve Body (10) into appropriate workstation.
- Install a new o-ring seal (22) into body seal groove (Figure A). A small amount of heavy grease is useful to hold the seal in place.
- Place Seat (21) into its pocket and press the seat against the seal (22) by hand (Figure B).
Figure A
Figure B
10
STEP 2
- Install Spider (20) into the body so that it sits on the Seat (21).
20
20
21

STEP 3

- Position the Ball (19) onto the Seat.
- Install a new Keeper Seal (18) unto the Keeper (17) and position it between the Seat and onto the Ball (19) as shown below.



STEP 4

- Stack Disk Springs (6) onto the Keeper (17) ensuring that the correct orientaiton and number of springs are used. (Reference Figure A for other configurations)

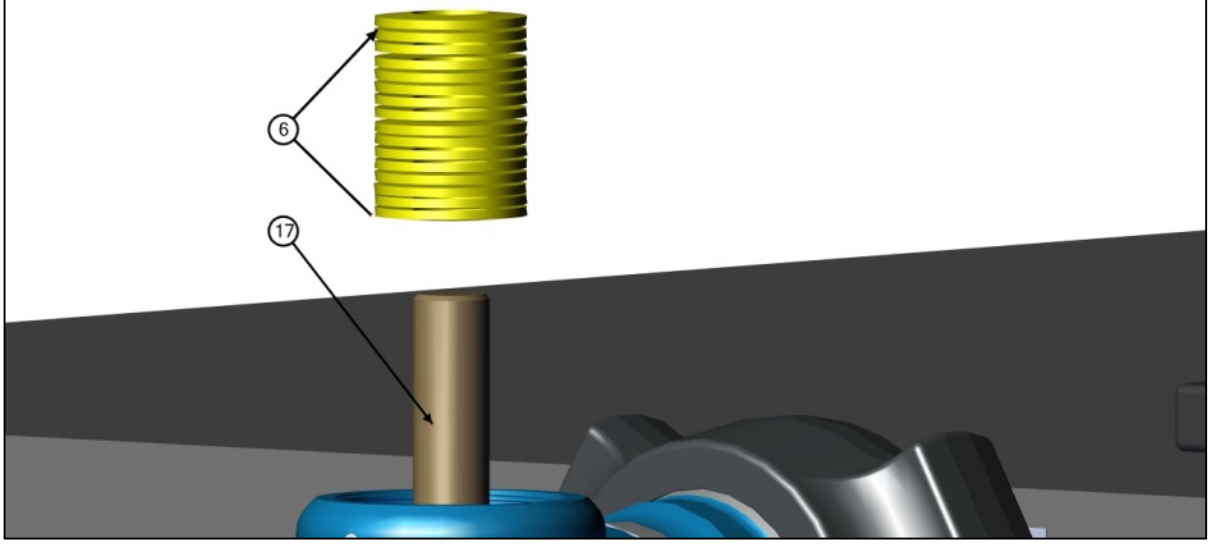


Figure A - Spring Disk Configurations

- Each Spring Relief Valve's designed "pop off" pressure is determined by the Spring Disk type and orientation.
- Below represents the correct orientation of the Springs with its respective "desired" pressure.

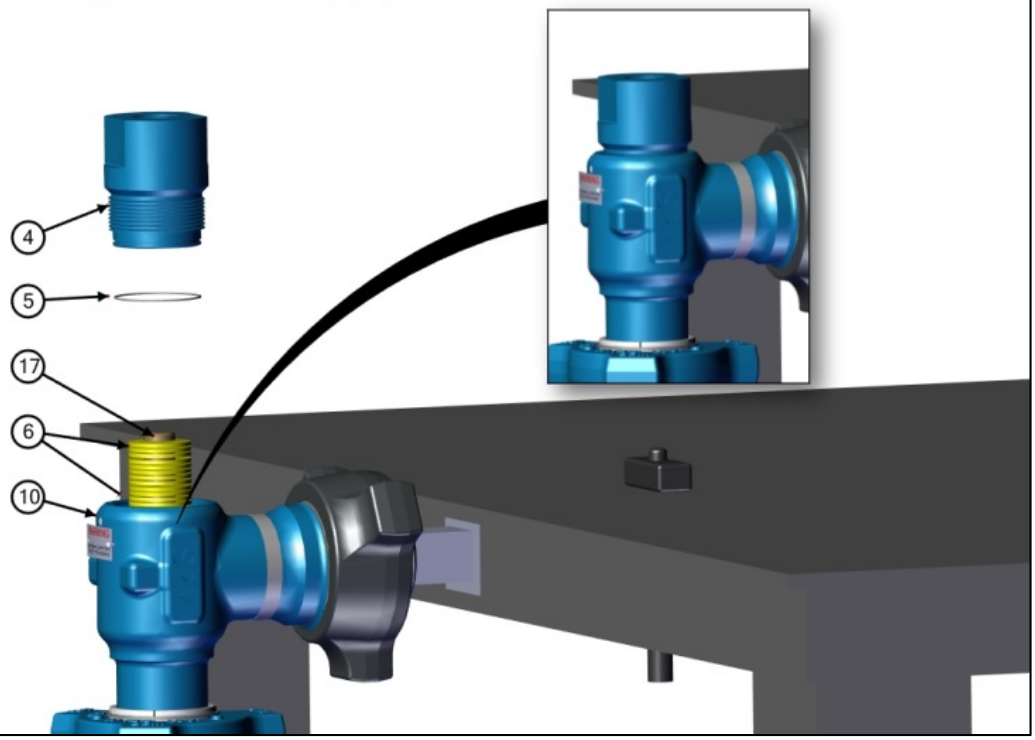
Note: Incorrect configuration of the springs may affect the spring rate and reduce the discharge capacity of the valve

Dual Stack Springs - 2 on top / 2 on bottom
3,000 PSI (2A23783, 2A23783V) - 20 Disks
15000 PSI (2A18192, 2A18192V) - 16 Disks
15,000 PSI (2A18138) - 16 Disks
10,000 PSI (2A18544) - 16 Disks
20,000 PSI (2A18796) - 16 Disks

Single Stack Springs - 1 on top / 1 on bottom
7,500 PSI (2A23782, 2A23782V)

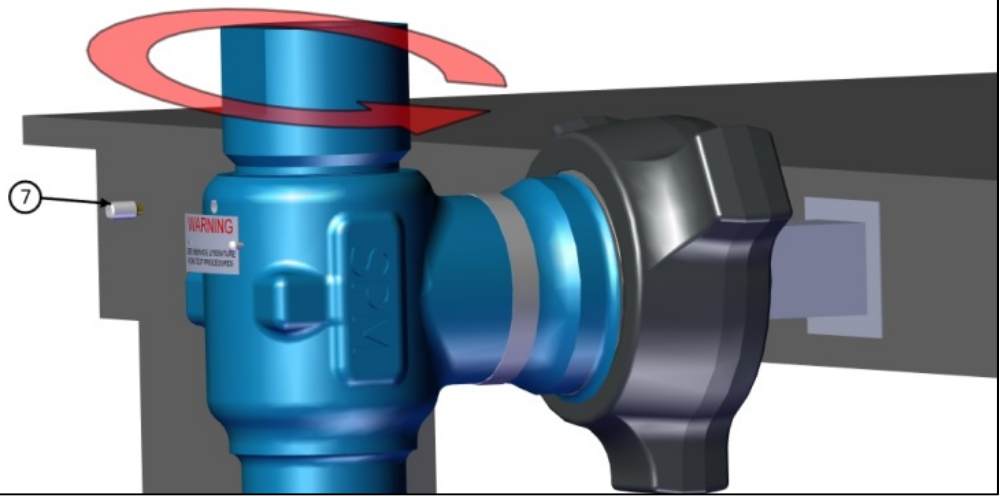
STEP 5

- Coat the Springs (6) and Keeper (17) liberally with grease.
- Install new Valve Cap Seal (5) into the o-ring groove in the Valve Cap (4).
- Install the Valve Cap Assembly into the Valve Body (10)



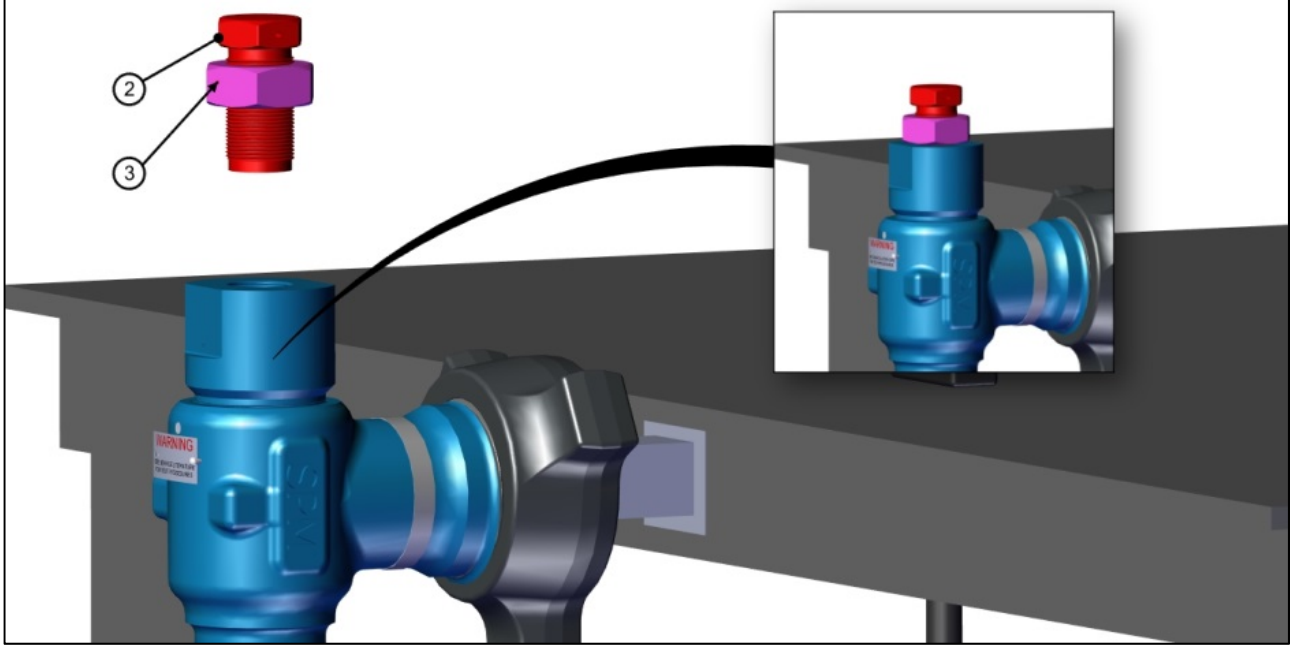
STEP 6

- Coat threads of the Valve Cap when installing it into Body. The Cap should freely thread into the Body with only Seal Friction creating drag.
- To fully tighten the Cap in the body, it is recommended that a 36" wrench be used and that the cap is smartly snapped against the stop. This will cause the bottom of the cap to bear against the spider, holding the ball seat firmly against the seat seal. The snapping action will guarantee a preload in the stackup of items.
- Install brass tipped Set Screw (7) into the body and use allen wrench to tighten snugly against the valve cap threads.

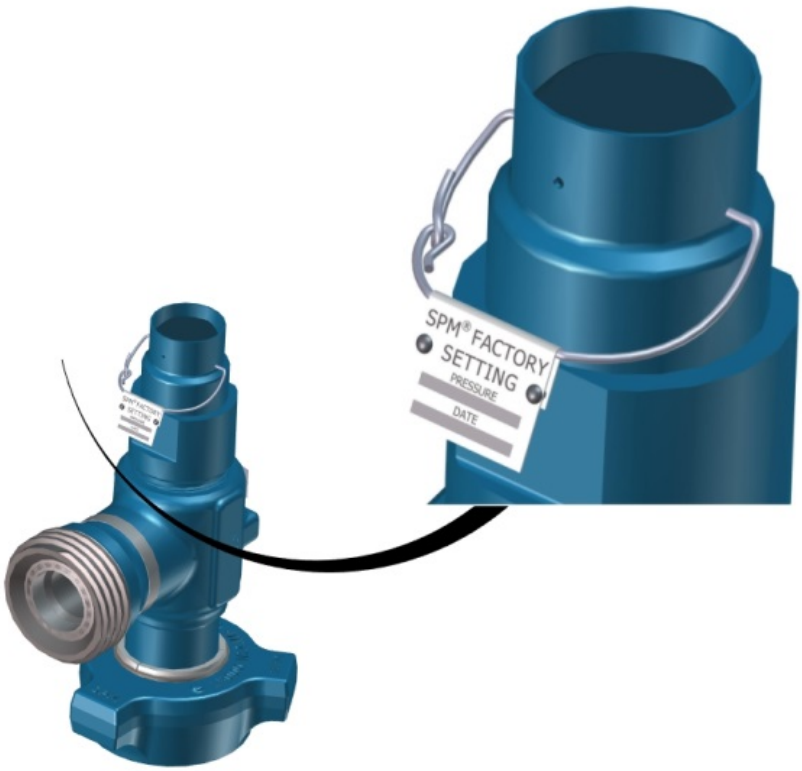


STEP 7

- The Lock Nut (3) should be screwed onto the Adjusting Screw (2), then this assembly can be screwed into the Cap after a liberal application of grease.
- The valve is now ready for pressure testing as discussed in "Setting & Adjusting Pressure" section.



Optional "Factory Seal" Installation"



Setting & Adjusting Pressure:

Factory

The 2" Emergency Relief Valve may be obtained from Weir Oil & Gas as "unset", "preset", or "preset and factory sealed".
Weir Oil & Gas bench tests and sets every valve to verify accuracy and function before shipping. If the valve is ordered as "unset", it will be tested for leaks and full pressure capability. The valve is then generally placed at a low (less than 1,000 psi) pressure setting for shipping.

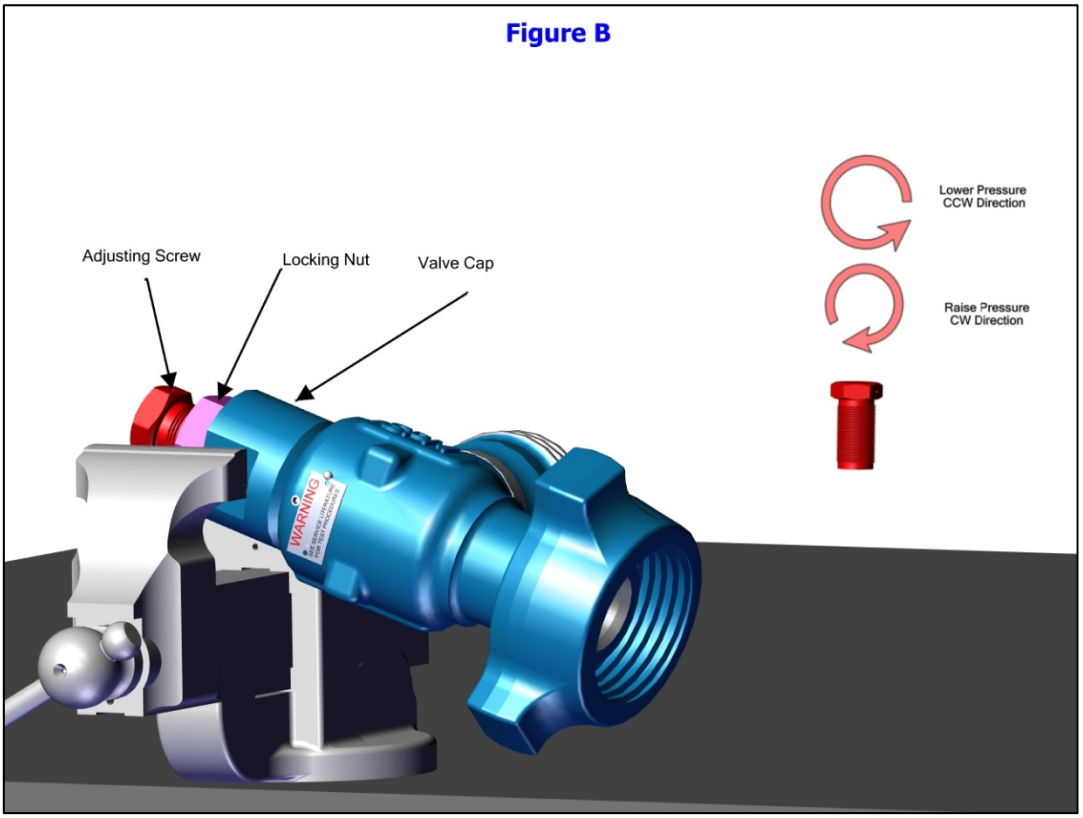
For the "preset" and "factory sealed" configuration, the valve is verified to full pressure capability and then set and locked at the required pressure. The "factory sealed" option provides for wire to be fed through the lock bolt that must be cut before the valve may be re-adjusted.

Field - Shop

For field situations where the valve must be adjusted after leaving the factory and a test facility is available, the following procedure applies.

1. Clamp the valve in a heavy duty vise as shown in Figure B. Loosen the lock nut around the adjusting screw by rotating the nut counterclockwise (L/H).
2. The set pressure can then be adjusted by rotating the adjusting screw either counterclockwise (L/H) to lower pressure or clockwise (R/H) to raise pressure.

Figure B



It should be noted that this is a direct acting relief valve that uses the spring forces to balance the fluid pressure. Consequently the forces needed to adjust the pressure can be quite high. It is recommended that a wrench with a minimum handle length of 72" be used to turn the adjusting screw.

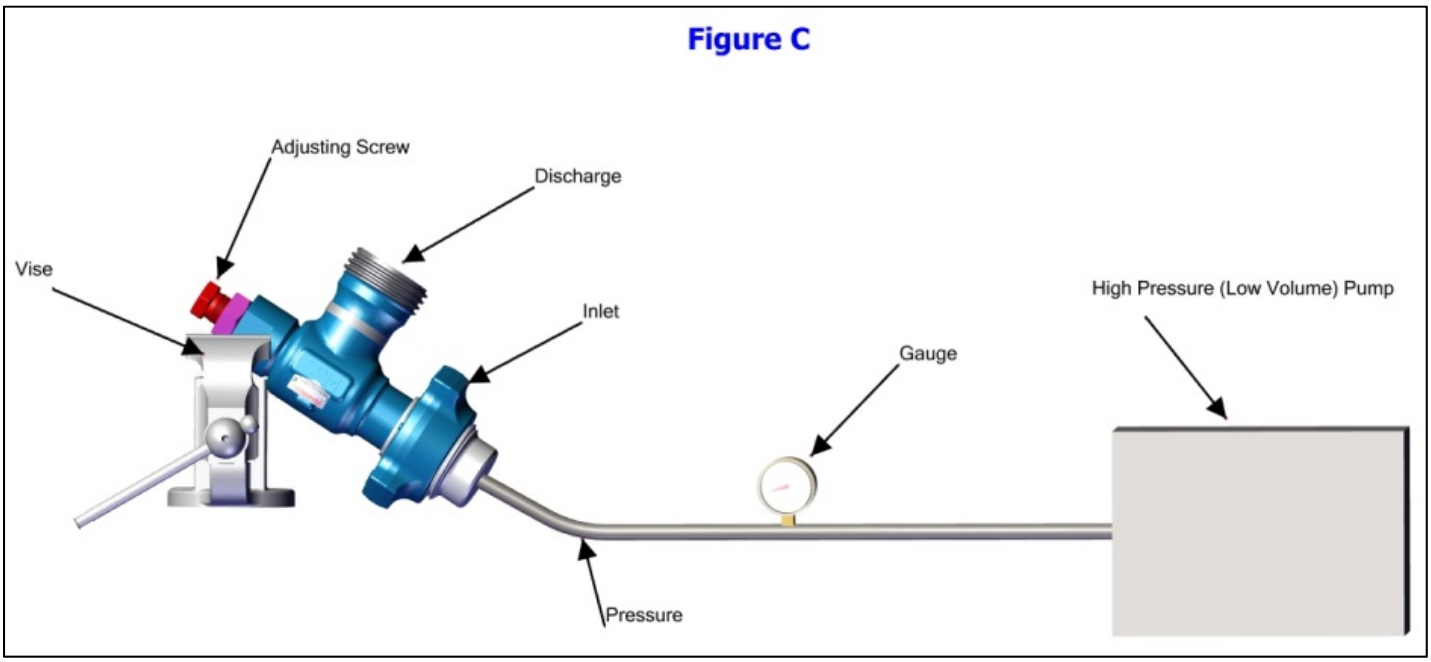
Setting and Adjusting Pressure Cont.

The pressure source should be a low volume liquid pump with sufficient pressure capacity to meet the set value requirement. The medium should be water or inert hydraulic oil suitable for this purpose.

All air must be purged from the valve and lines prior to building pressure. Trapped air becomes explosive under pressure, should the valve fail. THIS CAN CAUSE SERIOUS INJURY OF DEATH!

A recommended practice is to adjust the valve to full open (no pressure) prior to reset. The valve should be oriented with the inlet end slightly down and the discharge port turned up as shown in Figure C.

Figure C



By fully loosening the adjusting screw, the fluid will pass from the pump to the valve and purge the system of air.
The valve pressure setting can then be raised by rotating the adjusting screw clockwise (R/H) and monitoring the gauge reading until the desired level is achieved. Once the pressure is set, the lock bolt should be retightened against the top of the valve cap by turning it clockwise while holding the adjusting screw steady.

The procedure of rotating the adjusting screw acts to vary the load that the disk springs apply to the ball and seat.
With a given valve setting, the springs will cause the ball to bear against the seat with a given force. The hydraulic pressure of the system works against the bottom surface of the ball defined by the cross sectional areas of the seat throat. If the system pressure generates a force on the ball lower than the spring force applied to its top, the ball will remain seated. However, if the system pressure creates a force higher than the spring load, the ball will lift off the seat and allow fluid to discharge.

Setting and Adjusting Pressure Cont.

If the valve fails to hold pressure, the problem is generally one of the following:

a) Contamination between ball and seat holding the ball off seat
b) Damaged ball and seat
c) Damaged seat seal

To correct the problem, follow the instructions in Sections II and II of this manual; “Installation and Operation” and “Maintenance and Repair”.

Generally, at the start of a pressure pumping job, the customer will want to verify that the ERV will relieve at the intended pressure. This maximum pressure may be arrived at by the condition of the wellhead or down-hole equipment, or it may be dictated by the limits of the treating iron. It may also be arrived at for other reasons.

Consequently, each job is likely to vary in the required setting of the ERV. The valve can be initially set by counting the number of turns on the adjusting screw to get an approximation of desired set pressure. The valve can also be pre-set at the shop to the desired level.

The operator will then slowly bring his pump(s) on line and note at what pressure flow rate begins. This is the set pressure. If convenient, he can disconnect the discharge line of the valve and visually note at what pressure fluid discharges from the valve. This is the set pressure.

If the valve is not at the preferred setting, an increase or decrease in setting is accomplished by turning the adjustment screw. Then the pump is brought on again to confirm the right setting. By following this procedure, the serviceman and company man have confidence that an exact setting is affected and that the valve will perform as intended.

Weir Oil & Gas pressure tests all Emergency Relief Valves prior to shipping. Every valve is vessel tested to 150% of its rating to ensure safety and reliability. This vessel test should not be repeated.

Field testing should be done at working pressure only. It is still necessary to test each valve for leaks after they are refurbished. To test for leaks, follow instructions as previously described in this section. Adjust valve to full working pressure and allow the valve to relieve. To avoid damaging the ball and seat, do not do this more than once or twice.

CAUTION: DO NOT EXCEED WORKING PRESSURE With the valve near working pressure, carefully examine for leaks. If no leaks are observed, the valve is now ready for service.

Troubleshooting Guide

TROUBLESHOOTING GUIDE

Always follow existing Weir Oil & Gas procedures concerning identifying equipment for inspection, and removing equipment from service. The following is intended as a general guide in helping resolve most problems encountered in repairing emergency relief valves. If problems not covered here are encountered, contact Weir Oil & Gas for assistance at 1-800-342-7458.

	SYMPTOM		PROBLEM		SOLUTION
1.	Rapid erosion	a)	Used as continuous bypass	a)	Use only as an emergency pressure relief device
		b)	Used beyond rated capacity	b)	Install sufficient quantity of valves to meet capacity requirements
2.	Shuddering (Rapid opening and closing)	a)	Damaged gate (or gate & nozzle)	a)	Replace damaged parts
		b)	Relief valve located too close to pump's discharge	b)	Relocate Pressure Relief Valve. Refer to service literature for information on proper location.
3.	Loss of pressure (Valve does not seal or loses fluid through discharge)	a)	Valve not set properly	a)	Set valve correctly.
		b)	Damaged gate & Nozzle	b)	Replace damaged parts
		c)	Damaged discharge nozzle or fixed nozzle seals	c)	Replace seal
		d)	Cap not installed properly	d)	Fully install the cap #Item 2 in the body #Item 1 by uniformly tightening the screw #Item 22. Tighten evenly to 104 Ft-lb (lubricated). A small gap must remain between the cap and body
4.	Valve leaks through weephole or between valve body and cap	a)	Damaged inner or outer or both Spider seals	a)	Replace damaged seals
5.	Valve releases higher or lower than intended relief pressure	a)	Valve set incorrectly	a)	Reset valve to desired pressure per instructions in Section VII
		b)	Disk springs not installed correctly	b)	Reinstall disk spring pack. Reset valve

SECTION IV: Service and Support

Service Center Order Information:

Weir Oil and Gas stocks a large inventory of genuine original equipment replacement parts. In order to expedite a parts order and avoid any delays, please provide the following information with your order:

- The part number and description (refer to drawings and parts lists in this section) of each item ordered.
- The quantity of each part, kit, or assembly ordered.
- The model number and serial number.
- Your purchase order number.
- Specify method of shipment, complete shipping address, complete billing address and telephone number at the destination of the shipment.

Refer to location sheet on the following page.

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Solutions

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